

CLAIMS

I claim:

- 1 1. A method for causing hypothermia, said method comprising:
 - 2 providing a circulating fluid apparatus having a chiller and a flexible catheter, said
 - 3 catheter having an inner lumen and a hollow flexible heat transfer element
 - 4 adjacent its distal tip;
 - 5 inserting said catheter through the vascular system of a patient to place said heat
 - 6 transfer element in a portion of the vasculature;
 - 7 supplying chilled fluid to said inner lumen of said catheter;
 - 8 cooling the interior of said heat transfer element with said chilled fluid;
 - 9 cooling blood flowing in said portion of the vasculature with said heat transfer
 - 10 element; and
 - 11 returning said fluid to said chiller.

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1 2. A method for selective organ hypothermia, said method comprising:
2 providing a circulating fluid apparatus having a chiller and a flexible coaxial
3 catheter, said catheter having an insulated inner lumen and a hollow
4 flexible heat transfer element adjacent its distal tip;
5 inserting said catheter through the vascular system of a patient to place said heat
6 transfer element in a feeding artery of a selected organ;
7 supplying chilled perfluorocarbon fluid to said insulated inner lumen of said
8 coaxial catheter;
9 cooling the interior of said heat transfer element with said chilled perfluorocarbon
10 fluid;
11 cooling blood flowing in said feeding artery with said heat transfer element, to
12 enable said cooled blood to flow distally into said selected organ and cool
13 said organ; and
14 returning said perfluorocarbon fluid to said chiller.

1 3. A method for selective organ hypothermia, said method comprising:
2 providing a coaxial catheter, said catheter having an insulated inner lumen and a
3 metallic heat transfer element;
4 introducing said coaxial catheter into the vascular system of a patient to place said
5 metallic heat transfer element in a feeding artery of an organ of the patient;
6 cooling said metallic heat transfer element by circulating a refrigerant through
7 said insulated inner lumen of said coaxial catheter;
8 cooling blood in said feeding artery by contact with said cooled metallic heat
9 transfer element; and
10 cooling said organ by flow of said cooled blood through said feeding artery.

1 3. A method for selective organ hypothermia, said method comprising:
2 providing a coaxial catheter, said catheter having an insulated inner lumen and a
3 metallic heat transfer element;
4 introducing said coaxial catheter into the vascular system of a patient to place said
5 metallic heat transfer element in a feeding artery of an organ of the patient;
6 cooling said metallic heat transfer element by circulating a refrigerant through
7 said insulated inner lumen of said coaxial catheter;
8 cooling blood in said feeding artery by contact with said cooled metallic heat
9 transfer element; and
10 cooling said organ by flow of said cooled blood through said feeding artery.

1 4. A method for selective brain hypothermia, comprising:
2 providing a flexible coaxial catheter, said flexible catheter having an insulated
3 inner lumen and a flexible metallic heat transfer element;
4 introducing said flexible coaxial catheter into the vascular system of a patient to
5 place said flexible metallic heat transfer element in the carotid artery of the
6 patient;
7 cooling said flexible metallic heat transfer element by circulating a refrigerant
8 through said insulated inner lumen of said flexible coaxial catheter;
9 cooling blood in said carotid artery by contact with said cooled flexible metallic
10 heat transfer element; and
11 cooling the brain of the patient by flow of said cooled blood through said carotid
12 artery.

1 2 3 4 5 6 7 8 9 10 11 12

1 5. A method for selective hypothermia of the heart of a patient, comprising:
2 providing a flexible coaxial catheter, said flexible coaxial catheter having an
3 insulated inner lumen and a flexible metallic heat transfer element;
4 introducing said flexible coaxial catheter into the vascular system of a patient to
5 place said flexible metallic heat transfer element in a feeding artery of the
6 heart of the patient;
7 cooling said flexible metallic heat transfer element by circulating a refrigerant
8 through said insulated inner lumen of said flexible coaxial catheter;
9 cooling blood in said feeding artery by contact with said cooled flexible metallic
10 heat transfer element; and
11 cooling the heart of the patient by flow of said cooled blood through said feeding
12 artery..

1 5. A method for selective hypothermia of the heart of a patient, comprising:
2 providing a flexible coaxial catheter, said flexible coaxial catheter having an
3 insulated inner lumen and a flexible metallic heat transfer element;
4 introducing said flexible coaxial catheter into the vascular system of a patient to
5 place said flexible metallic heat transfer element in a feeding artery of the
6 heart of the patient;
7 cooling said flexible metallic heat transfer element by circulating a refrigerant
8 through said insulated inner lumen of said flexible coaxial catheter;
9 cooling blood in said feeding artery by contact with said cooled flexible metallic
10 heat transfer element; and
11 cooling the heart of the patient by flow of said cooled blood through said feeding
12 artery..

1 6. An apparatus for selective organ hypothermia, said apparatus comprising:
2 a circulating unit adapted for chilling and circulating a fluid;
3 a flexible elongated catheter;
4 a flexible tubular outer catheter body on said catheter;
5 a flexible fluid supply tube within said outer catheter body, a proximal end of a
6 central lumen of said fluid supply tube being connected in fluid flow
7 communication with an outlet of said circulating unit;
8 a fluid return lumen within said outer catheter body, a proximal end of said fluid
9 return lumen being connected in fluid flow communication with an inlet
10 of said circulating unit; and
11 a flexible heat transfer element mounted to a distal end of said outer catheter
12 body, said heat transfer element having a partially helical shape to
13 increase the surface area available for heat transfer.

1 2 3 4 5 6 7 8 9 10 11 12 13

1 7. A cooling apparatus, comprising:

2 a circulating unit adapted for chilling and circulating a fluid;

3 a flexible elongated catheter;

4 a flexible tubular outer catheter body on said catheter;

5 a flexible, insulated, supply tube within said outer catheter body, a proximal end

6 of a central lumen of said supply tube being connected in fluid flow

7 communication with an outlet of said circulating unit;

8 a return lumen within said outer catheter body, said return lumen substantially

9 surrounding said fluid supply tube, a proximal end of said return lumen

10 being connected in fluid flow communication with an inlet of said

11 circulating unit; and

12 a flexible heat transfer element mounted to a distal end of said outer catheter

13 body, said heat transfer element having a partially helical shape to increase

14 the surface area available for heat transfer;

15 wherein said fluid supply tube comprises a wall having insulating properties to

16 reduce heat transfer from said return lumen to said central lumen of said

17 fluid supply tube.

1 8. An apparatus for causing hypothermia, said apparatus comprising:
2 a circulating unit adapted for chilling and circulating a fluid;
3 a flexible elongated catheter;
4 a flexible tubular outer catheter body on said catheter;
5 a flexible fluid supply tube within said outer catheter body, a proximal end of a
6 central lumen of said fluid supply tube being connected in fluid flow
7 communication with an outlet of said circulating unit;
8 a fluid return lumen within said outer catheter body, a proximal end of said fluid
9 return lumen being connected in fluid flow communication with an inlet
10 of said circulating unit; and
11 a flexible heat transfer element mounted to a distal end of said outer catheter
12 body, said heat transfer element having an at least partially ballooned
13 shape to increase the surface area available for heat transfer.

1 2 3 4 5 6 7 8 9 10 11 12 13

1 9. An apparatus for causing hypothermia, said apparatus comprising:

2 a circulating unit adapted for chilling and circulating a fluid;

3 a flexible elongated catheter;

4 a flexible tubular outer catheter body on said catheter;

5 a flexible fluid supply tube within said outer catheter body, a proximal end of a

6 central lumen of said fluid supply tube being connected in fluid flow

7 communication with an outlet of said circulating unit;

8 a fluid return lumen within said outer catheter body, a proximal end of said fluid

9 return lumen being connected in fluid flow communication with an inlet

10 of said circulating unit; and

11 a flexible heat transfer element mounted to a distal end of said outer catheter

12 body, said heat transfer element having an at least partially oval shape to

13 increase the surface area available for heat transfer.